# 5. Shoreline Information

## 5.1. Shoreline Types and Sensitivity

The following text and charts are in draft form, and are intended to serve as a training tool for countermeasure contingency planning and implementation for shoreline areas in Federal Region X. Shoreline countermeasure processes evolve to reflect increasingly efficient treatment techniques. Accordingly, the following information will be altered as new information is added.

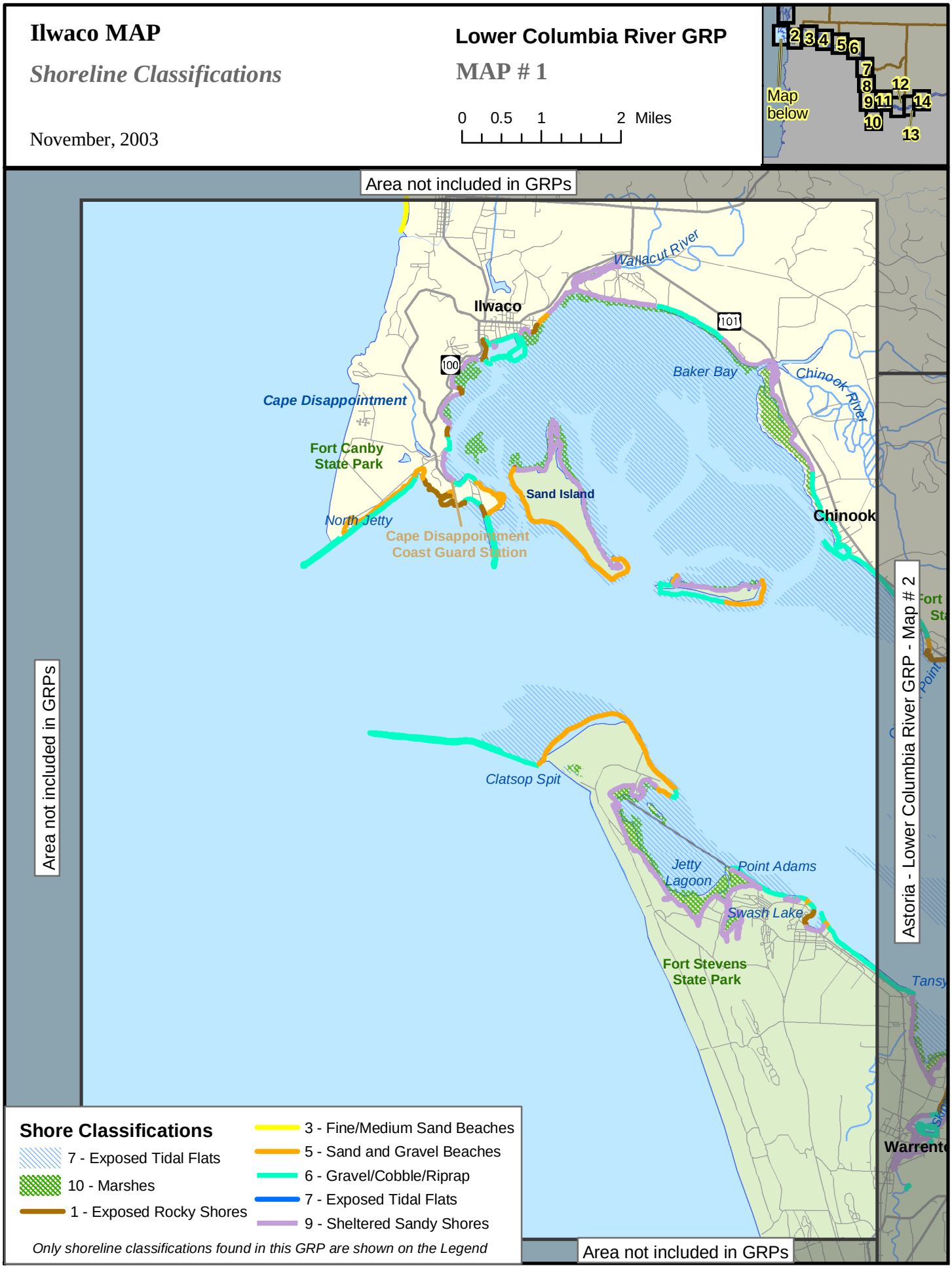
The type of shoreline, degree of exposure to waves and currents, and biological sensitivity are the main criteria for selecting appropriate treatment techniques. Each shoreline type has particular properties (including vegetation types) which facilitate or resist the penetration and persistence of oil. Areas of comparatively uniform sediment type and grain size experience a deeper penetration of oil. Grain size definitions are:

| | |
|---|---|
| Mud | <0.0625 mm |
| Fine Sand | 0.0625 - 2 mm |
| Medium to Coarse Sand | 2 -4 mm |
| Pebble/Cobble | 4 - 256 mm |

Persistence of oil in a particular area is directly related to the intensity of wave action, tides, and currents. Based on numerous oil spill studies of shoreline characteristics, treatment, and oil impact, the matrices referred to in Section 5.3 were formulated following the basic prototype of the Environmental Sensitivity Index Atlas.

The environmental sensitivity index (ESI) system ranks coastal environments on a scale of 1-10 or 11 (less sensitive to more sensitive) with respect to oil spill sensitivity and potential biological injury is being used for mapping extensive areas of the coastline of the U.S.. Generally speaking, areas exposed to high levels of physical energy, such as wave action and tidal currents, rank low on the scale while sheltered areas have the highest ranking. The shoreline types used in this manual are a combination of the two similar systems used for the Delaware/Pennsylvania/New Jersey ESI Atlas, and the Maryland and Virginia atlases. The numbering system for the Countermeasure Manual Shoreline Types does not correspond exactly to either atlas; however, the corresponding shoreline types can be identified easily from the ESI maps and reassigned the appropriate number (after field verification.) The shoreline ranking system provides a useful first step in the design of contingency plans because it identifies the priority areas that require maximum effort for protection and cleanup. Strike teams and contractors with this document can focus their activities on environmental priorities, particularly during the first few hours and days of the spill.[4]

[4]Regional Response Team III. Draft, *Shoreline Countermeasures Manual.* (Departmentof the Interior, March 22,1991).


Ilwaco MAP
Shoreline Classifications
November, 2003
Lower Columbia River GRP
MAP # 1
0 0.5 1 2 Miles
Map below
2 3 4 5 6 7 8 9 10 11 12 13 14
Area not included in GRPs
Wallacut River
Ilwaco
101
100
Baker Bay
Chinook River
Cape Disappointment
Fort Canby State Park
Sand Island
North Jetty
Cape Disappointment Coast Guard Station
Chinook
Area not included in GRPs
Astoria - Lower Columbia River GRP - Map # 2
Clatsop Spit
Jetty Lagoon
Point Adams
Swash Lake
Fort Stevens State Park
Tansy
Warrento
Area not included in GRPs
Shore Classifications
7 - Exposed Tidal Flats
10 - Marshes
1 - Exposed Rocky Shores
3 - Fine/Medium Sand Beaches
5 - Sand and Gravel Beaches
6 - Gravel/Cobble/Riprap
7 - Exposed Tidal Flats
9 - Sheltered Sandy Shores
Only shoreline classifications found in this GRP are shown on the Legend

# Astoria MAP

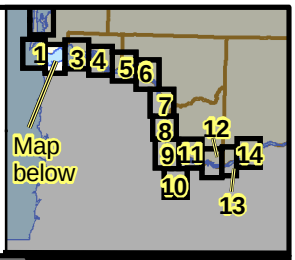
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 2**

0 0.5 1 2 Miles




**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend*

Area not included in GRPs

Chinook

Fort Columbia State Park

Chinook Point

Grays Point

Point Ellice

Brix Bay

Ilwaco - Lower Columbia River GRP - Map # 1

Grays Bay - Lower Columbia River GRP - Map # 3

Point Adam

Swash Lake

Tongue Point

Mott Island

Tansy Point

Lois Island

Cathlame

Astoria

Skipanon Waterway

Youngs Bay

Daggett Pt

John Day River

Warrenton

Lewis & Clark R

Jeffers Slough

Cook Slough

Young River

Wallooskee River

Barrett Slough

Green Slough

John Day River

Area not included in GRPs

# Grays Bay MAP

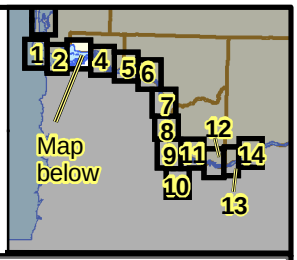
*Shoreline Classifications*

November, 2003

## Lower Columbia River GRP

MAP # 3

0 0.5 1 2 Miles




Area not included in GRPs

**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend*

Astoria - Lower Columbia River GRP - Map # 2

Cathlamet - Lower Columbia River GRP - Map # 4

Sisson Creek
Deep River
Oneida
Grays River
Brix Bay
Crooked Creek
Grays Bay
Grays Point
Harrington Point
Jim Crow Creek
Miller Sands
Woody Island
Horseshoe Island
Marsh Island
Lewis and Clark National Wildlife Refuge
Long Island
Grizzly Slough
Green Island
Seal Island
Prairie Channel
Karlson Island
Blind Slough
Warren Slough
Tongue Point
Mott Island
Lois Island
Cathlamet Bay
Russian Island
Minaker Island
Knappa
Gnat Creek
John Day River
Svensen Island
Svensen
Eskeline Creek
Mary's Creek
Boar Creek
Ferris Creek
Little Creek
Big Creek
John Day River

Area not included in GRPs

# Cathlamet MAP

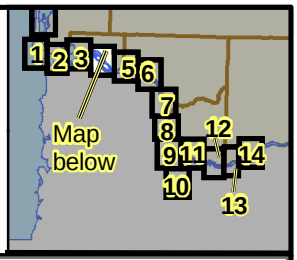
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 4**

0 0.5 1 2 Miles




Area not included in GRPs

**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend*

Grays Bay - Lower Columbia River GRP - Map # 3

Crims Island - Lower Columbia River GRP - Map # 5

Skamokawa

Skamokawa Ck

Brooks Slough

Steamboat Slough

Price Island

Skamokawa Channel

Fitzpatrick Island

Woody Island

Quinns Island

Welch Island

Red Slough

Aldrich Point

Columbia White-Tailed Deer National Wildlife Refuge

Elochoman Slough

Elochoman River

Hunting Islands

Tenasillahe Island

Long Isla

Clifton Channel

Clifton

Ryan Island

Bernie Slough

Cathlamet

Cathlamet Channel

Little Island

Puget Island

Welcome Slough

409

30

Jackson Island

Wauna

Whites Island

Cut-Off Slough

Net Rack Slough

Ferry

Drscoll Slough

Westport Slough

Wallace Slou

Area not included in GRPs

# Crims Island MAP

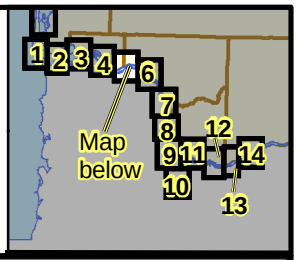
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 5**

0 0.5 1 2 Miles




Area not included in GRPs

**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend*

Cathlamet - Lower Columbia River GRP - Map # 4

Longview - Lower Columbia River GRP - Map # 6

Abernathy Creek

Germany Creek

Mill Creek

Gull Island

Coal Creek Slough

County-line Park

Crims Island

Bradbury Slough

Green Point

Locoda

John Slough

Wallace Island

Wallace Slough

Beaver Slough

Clatskanie River

4

30

Area not included in GRPs

# Longview MAP

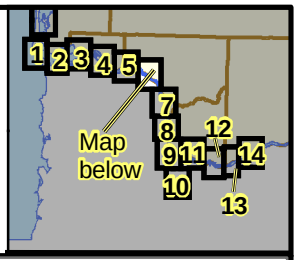
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 6**

0 0.5 1 2 Miles




Area not included in GRPs

**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend*

Crims Island - Lower Columbia River GRP - Map # 5

Area not included in GRPs

Willow Grove County Park

Coal Creek

Cut-Off Slough

Fisher's Slough

Fisher Island

Hump Island

Walker Island

Barlow Point

Lord Island

Slaughters Dike

City of Longview

Kelso

Port of Longview

Cowlitz River

Carrolls Channel

Rainier

Cottonwood Island

Prescott

Kalama River

4

432

411

433

30

5

Area not included in GRPs

Kalama - Lower Columbia River GRP - Map # 7

# Kalama MAP

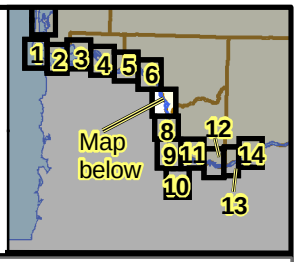
*Shoreline Classifications*

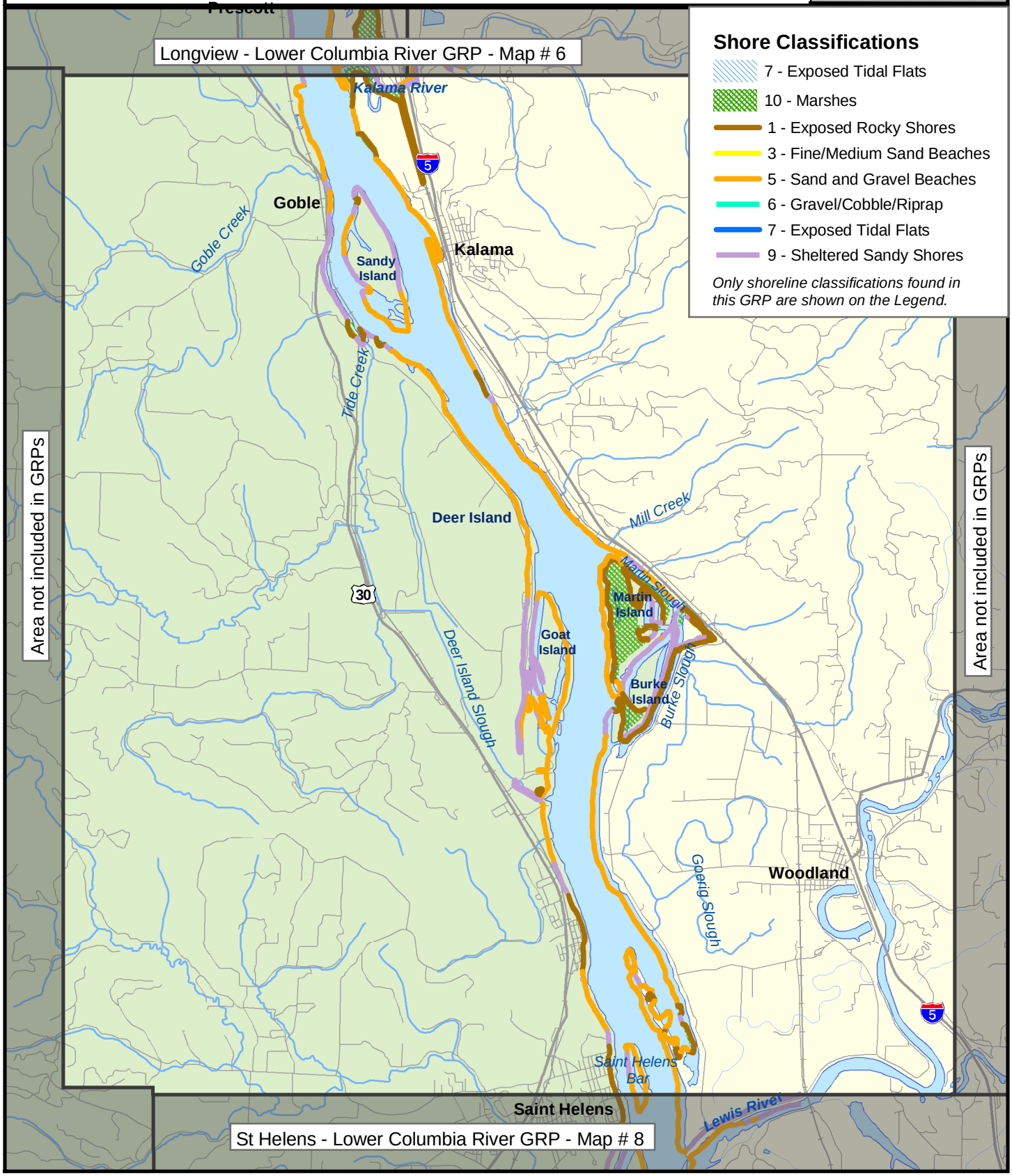
November, 2003

**Lower Columbia River GRP**

**MAP # 7**

0 0.5 1 2 Miles



# St Helens MAP

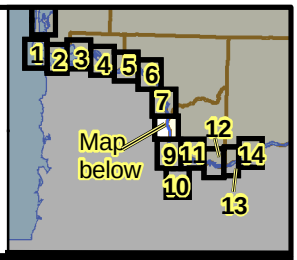
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 8**

0 0.5 1 2 Miles




**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

Kalama - Lower Columbia River GRP - Map # 7

Saint Helens Bar

Saint Helens

Lewis River

Multnomah Channel

Gee Creek

Lake River

Gee Creek

Bachelor Island

Bachelor Island Slough

Ridgefield

Ridgefield National Wildlife Refuge

Area not included in GRPs

Area not included in GRPs

Campbell Lake

Lake River

Willow Point

Post Office Lake

Sturgeon Lake

Willow Bar Islands

Multnomah Channel

Horseshoe Island

Portland - Lower Columbia River GRP - Map # 9

Caterpillar Island

# Portland MAP

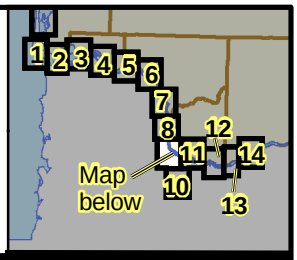
*Shoreline Classifications*

November 2003

**Lower Columbia River GRP**

**MAP # 9**

0 0.5 1 2 Miles




St Helens - Lower Columbia River GRP - Map # 8

Area not included in GRPs

Government Island - Lower Columbia River GRP - Map # 11

Willamette River - Lower Columbia River GRP - Map # 10

Horseshoe

Multnomah Channel

Caterpillar Island

Sauvie Island

Frenchmans Bar Park

Vancouver Lake

Vancouver Lake Flushing Channel

Belle Vue Point

Kelley Point

City of Vancouver

Port of Vancouver

Hayden Island

Columbia Slough

Bybee Lake

North Portland Harbor

Smith Lake

Tomahawk Island

Cathedral Park

St John Bridge

Doane Point

Brulington Northern RR Bridge

Port of Portland

Swan Island Basin

Swan Island

Willamette River

Portland

Freemont Bridge

Broadway Bridge

Portland

Columbia Slo

Point

hawk

and

## Shore Classifications

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

# Willamette River MAP

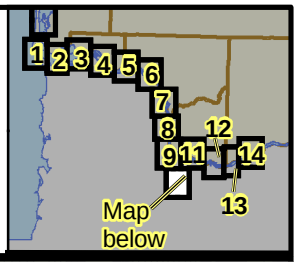
*Shoreline Classifications*

November, 2003

## Lower Columbia River GRP

MAP # 10

0 0.5 1 2 Miles




Portland - Lower Columbia River GRP - Map # 9

Government Island - Lower Columbia River GRP - Map # 11

Area not included in GRPs

Area not included in GRPs

Area not included in GRPs

**Shoreline Classification Information is not Available for the Willamette River**

Burnside Bridge

Morrison Bridge

Hawthorne Bridge

OMSI

Portland

Ross Island Bridge

Ross Island

Hardtack Island

Stevens Point

The Oaks

Sellwood Bridge

Johnson Creek

Milwaukie

Kellogg Lake

Oswego Creek

George Waters Park

Hog Island

Cedar Island

Meldrum Slough

Clackamas Rapids

Clackamas River

Abernethy Creek

Oregon City

Willamette Falls

Johnson Creek

405

26

10

5

99

205

### Shore Classifications

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 8 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

# Government Island MAP

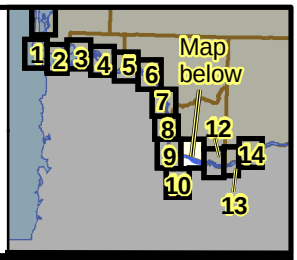
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 11**

0 0.5 1 2 Miles




Area not included in GRPs

**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

Portland - Lower Columbia River GRP - Map # 9

Camas - Lower Columbia River GRP - Map # 12

Marine Park Boat Ramp

Ryan Point

Wintler Park

Tomahawk Island

Lieser Point

City of Vancouver

Steamboat Landing

Sentry Gravel Pit

Lemon Island

Sand Island

Columbia Slough

Government Island

Jewit Lake

McGuire Island

Portland

Area not included in GRPs

# Camas MAP

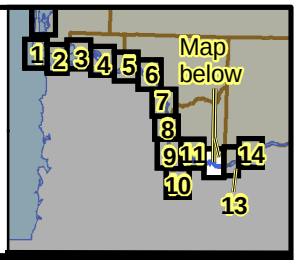
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 12**

0 0.5 1 2 Miles




Area not included in GRPs

Government Island - Lower Columbia River GRP - Map # 11

Rooster Rock State Park - Lower Columbia River GRP - Map # 13

City of Camas

Washougal River

City of Washougal

Port of Camas-Washougal

Camas Slough

Lady Island

Guire Is

Sandy River

Gary Island

Reed Island

Lawton Creek

Point Vancouver

Lewis and Clark State Park

500

14

84

30

**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

Area not included in GRPs

# Rooster Rock State Park MAP

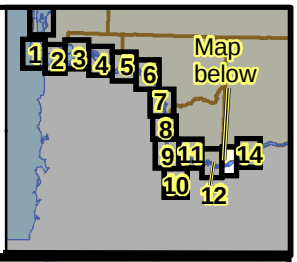
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 13**

0 0.5 1 2 Miles




**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

Area not included in GRPs

Camas - Lower Columbia River GRP - Map # 12

Bonneville - Lower Columbia River GRP - Map # 14

Lawton Creek

Point Vancouver

Reed Island

Sand Island

Rooster Rock State Park

Skamania Islan

Franz Lake

Skama

Horsetail

14

84

30

Area not included in GRPs

# Bonneville MAP

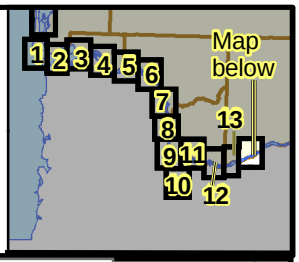
*Shoreline Classifications*

November, 2003

**Lower Columbia River GRP**

**MAP # 14**

0 0.5 1 2 Miles




**Shore Classifications**

- 7 - Exposed Tidal Flats
- 10 - Marshes
- 1 - Exposed Rocky Shores
- 3 - Fine/Medium Sand Beaches
- 5 - Sand and Gravel Beaches
- 6 - Gravel/Cobble/Riprap
- 7 - Exposed Tidal Flats
- 9 - Sheltered Sandy Shores

*Only shoreline classifications found in this GRP are shown on the Legend.*

Area not included in GRPs

Area not included in GRPs

Rooster Rock State Park - Lower Columbia River GRP - Map # 13

Area not included in GRPs

Hamilton Creek
Greenleaf Slough
Hardy Creek
Bonneville Dam
Bradford Island
Bonneville
Hamilton Island
Beacon Rock State Park
Ives Island
Pierce Island
Skamania Landing
14
84
Warrendale
30
Franz Lake
Skamania Island
Oneonta Creek
Horsetail Creek

### 5.3 Shoreline Countermeasure Matrices

The matrices included here show which shoreline countermeasure techniques have been considered for the fourteen shoreline types described in Chapter 2 of the "Shoreline Countermeasures Manual & Matrices", Northwest Area Plan, Chapter 9650, Page 9-37. Four matrices have been constructed for the major categories of oil (heavy, medium, light, very light).

Countermeasure methods are described in Chapters 3 and 4 of the manual. Countermeasures in Chapter 3 are traditional or conventional techniques that the OSC can use without any additional concurrence. However, the cutting of vegetation countermeasure should be used only during specific seasonal windows under specific conditions and with landowner approval. Countermeasures in Chapter 4 are described under a separate section called "Shoreline Countermeasure Methods Using Alternative Technology" may be useful in certain situations. These methods are considered more experimental and controversial in their application and potential impacts and require more formal review and consultation before implementing. The exact requirements are spelled out in the National Contingency Plan and the Northwest Area Plan. The Shoreline Countermeasures Matrices are a particularly dynamic component of the manual and should continue to be revised as the existing techniques are used and evaluated, and as both old and new techniques are refined.

Each matrix has a written explanation of how it is to be used as a countermeasure advisability matrix. The matrices are only a general guide for removing oil from shoreline substrates. They must be used in conjunction with the entire "Shoreline Countermeasures Manual" plus field observations and scientific advice. The countermeasures listed are not necessarily the best under all circumstances, and any listed technique may need to be used in conjunction with other techniques (including ones not listed herein). The Federal On-Scene Coordinator (FOSC) or the State OSC operating with the FOSC's authorization has the responsibility for and authority to determine which countermeasure(s) are appropriate for the various situations encountered.

Selection of countermeasure techniques to be used in each spill is based upon the degree of oil contamination, shoreline types, and the presence of sensitive resources. Extremely sensitive areas are generally limited to manual cleanup methods. It is important to note that the primary goal of countermeasure implementation is the removal of oil from the shoreline with no further injury or destruction to the environment. The three categories of guidance used in the matrices are defined as follows:

| | | |
|---|---|---|
| R | Recommended | May be the preferred method that best achieves the goal of minimizing destruction or injury to the environment |
| C | Conditional | Viable and possibly useful but may result in limited adverse effects to the environment |
| | Shaded | Not applicable or not generally recommended. |

# SHORELINE COUNTERMEASURES MATRIX

## Heavy Oil (Heavy Crude Oils, Intermediate Fuel Oils, Bunker C & Heavily Weathered Medium Crudes)

- Heavy oils with little or no evaporation or dissolution
- Water-soluble fraction likely to be <10ppm
- Heavy contamination of intertidal areas likely
- Severe impacts to waterfowl and fur-bearing mammals (coating and ingestion)
- Long-term contamination to sediments possible
- Weathers very slowly
- Dispersion seldom effective
- Shoreline cleanup difficult under all conditions

### SHORELINE TYPES CODES

1- Exposed rock shores and vertical, hard man-made structure (e.g. seawalls)
2 - Exposed wave-cut platforms
3 - Fine to medium grained sand beaches & steep unvegetated river banks
4 - Course grained sand beaches
5 - Mixed sand and gravel beaches, including artificial fill containing a range of grain size and material
6A - Gravel beaches - pebbles to cobble
6B - Gravel beaches - cobbles to boulders
6C - Exposed rip rap
7 - Exposed tidal flat
8A- Sheltered vertical rock shores and vertical, hard man-made structures (e.g. seawalls, docks, bulkheads)
8B - Sheltered rubble slope
9A - Sheltered sand and mud flats
9B - Sheltered vegetated low bank
10 - Marshes

| COUNTERMEASURES | SHORELINE TYPES 1 | 2 | 3 | 4 | 5 | 6A | 6B | 6C | 7 | 8A | 8B | 9A | 9B | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONVENTIONAL METHODS | | | | | | | | | | | | | | |
| No action | C | C | C | C | C | C | C | C | R | C | C | R | C | R |
| Manual removal of oil | C | R | R | R | R | C | C | C | | R | R | | C | C |
| Passive collection of oil | R | R | R | R | R | R | R | R | C | R | R | C | R | R |
| Oiled debris removal | C | R | R | R | R | R | R | R | C | R | R | C | R | C |
| Trenching/recovery wells | | | C | C | C | | | | | | | | | |
| Oiled sediment removal | | | C | C | C | C | | C | | | | | C | |
| Ambient water flooding (Deluge) | | | C | C | C | R | R | R | | R | R | | C | C |
| Amb water flush <50 psi | C | C | | | C | R | C | R | | C | C | | C | C |
| Amb water flush <100 psi | C | C | | | | | C | C | | C | C | | | |
| Warm water flush <90°F | C | | | | | | C | C | | C | | | | |
| Hot water flush >90°F | C | | | | | | | | | C | | | | |
| Vacuum removal of oil | C | C | C | C | C | C | C | C | | C | C | | C | C |
| Sediment reworking | | | C | C | C | C | | | | | | | | |
| Sediment Removal-cleaning-replacement | | | C | C | C | C | | C | | | | | | |
| Cutting oiled vegetation | | | | | | | C | C | | C | C | | C | C |
| ALTERNATIVE METHODS* | | | | | | | | | | | | | | |
| In-situ burning on shore | | | | | | | | | | | | | | |
| Chemical stabilization, protection, cleaning | | | | | | | | | | | | | | |
| Nutrient enhancement | | | C | C | C | C | C | C | | | | | | C |
| Microbial addition | | | | | | | | | | | | | | |

**R** Recommend - May be Preferred Alternative
**C** Conditional (Refer to NW Shoreline Countermeasures Manual)
Shaded areas are Not Applicable or Not Generally Recommened
***** Follow approved process defined in NCP and NW Area Plan

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# SHORELINE COUNTERMEASURES MATRIX

## Medium Oil (Most Crude Oils & Some Heavily Weathered Light Crudes)

- About 1/3 will evaporate within 24 hours
- Maximum water-soluble fraction is 10-100ppm
- Oil contamination of intertidal areas can be severe and long-term
- Impact to waterfowl and fur-bearing mammals can be severe
- Chemical dispersion is an option within 1-2 days
- Cleanup most effective if conducted quickly

### SHORELINE TYPES CODES

1- Exposed rock shores and vertical, hard man-made structure (e.g. seawalls)
2 - Exposed wave-cut platforms
3 - Fine to medium grained sand beaches & steep unvegetated river banks
4 - Course grained sand beaches
5 - Mixed sand and gravel beaches, including artificial fill containing a range of grain size and material
6A - Gravel beaches - pebbles to cobble
6B - Gravel beaches - cobbles to boulders
6C - Exposed rip rap
7 - Exposed tidal flat
8A- Sheltered vertical rock shores and vertical, hard man-made structures (e.g. seawalls, docks, bulkheads)
8B - Sheltered rubble slope
9A - Sheltered sand and mud flats
9B - Sheltered vegetated low bank
10 - Marshes

| COUNTERMEASURES | SHORELINE TYPES 1 | 2 | 3 | 4 | 5 | 6A | 6B | 6C | 7 | 8A | 8B | 9A | 9B | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONVENTIONAL METHODS | | | | | | | | | | | | | | |
| No action | C | C | C | C | C | C | C | C | R | C | C | R | C | R |
| Manual removal of oil | C | R | R | R | R | C | C | C | | R | R | | C | C |
| Passive collection of oil | R | R | R | R | R | R | R | R | C | R | R | R | R | R |
| Oiled debris removal | C | R | R | R | R | R | R | R | C | R | R | C | R | C |
| Trenching/recovery wells | | | C | C | C | | | | | | | | | |
| Oiled sediment removal | | | C | C | C | C | | | | | | | C | |
| Ambient water flooding (Deluge) | | | C | C | C | R | R | R | | R | R | | C | C |
| Amb water flush <50 psi | C | C | | | C | R | C | R | | R | R | | C | C |
| Amb water flush <100 psi | C | C | | | | | C | C | | C | | | | |
| Warm water flush <90°F | C | | | | | | C | C | | C | | | | |
| Hot water flush >90°F | C | | | | | | | | | C | | | | |
| Vacuum removal of oil | C | C | R | R | | C | R | R | | C | C | | C | C |
| Sediment reworking | | | C | C | C | C | | | | | | | | |
| Sediment Removal-cleaning-replacement | | | C | C | C | C | | C | | | C | | | |
| Cutting oiled vegetation | | | | | | | C | C | | C | C | | C | C |
| ALTERNATIVE METHODS* | | | | | | | | | | | | | | |
| In-situ burning on shore | | | | | | | | | | | | | | |
| Chemical stabilization, protection, cleaning | | | | | | | | | | | | | | |
| Nutrient enhancement | | | C | C | C | C | C | C | | | C | | | C |
| Microbial addition | | | | | | | | | | | | | | |

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# SHORELINE COUNTERMEASURES MATRIX

## Light Oil (Diesel, No 2 Fuel Oils, Light Crudes)

- Moderately volatile; will leave residue (up to 1/3 of spilled amount)
- Moderate concentrations of toxic (soluble) compounds
- Long-term contamination of intertidal resources possible
- Potential for subtidal impacts (dissolution, mixing, sorption onto suspended sediments)
- No dispersion necessary
- Cleanup can be very effective

### SHORELINE TYPES CODES

1- Exposed rock shores and vertical, hard man-made structure (e.g. seawalls)
2 - Exposed wave-cut platforms
3 - Fine to medium grained sand beaches & steep unvegetated river banks
4 - Course grained sand beaches
5 - Mixed sand and gravel beaches, including artificial fill containing a range of grain size and material
6A - Gravel beaches - pebbles to cobble
6B - Gravel beaches - cobbles to boulders
6C - Exposed rip rap
7 - Exposed tidal flat
8A- Sheltered vertical rock shores and vertical, hard man-made structures (e.g. seawalls, docks, bulkheads)
8B - Sheltered rubble slope
9A - Sheltered sand and mud flats
9B - Sheltered vegetated low bank
10 - Marshes

| COUNTERMEASURES | SHORELINE TYPES 1 | 2 | 3 | 4 | 5 | 6A | 6B | 6C | 7 | 8A | 8B | 9A | 9B | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONVENTIONAL METHODS | | | | | | | | | | | | | | |
| No action | **R** | **R** | **C** | **C** | **C** | **C** | **C** | **C** | **R** | **C** | **C** | **R** | **C** | **R** |
| Manual removal of oil | | | **C** | **C** | **C** | **C** | **C** | **C** | | **R** | **R** | | **C** | |
| Passive collection of oil | **C** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **C** | **R** | **R** | **C** | **R** | **R** |
| Oiled debris removal | **C** | **C** | **R** | **R** | **R** | **R** | **R** | **R** | **C** | **R** | **R** | **C** | **C** | **C** |
| Trenching/recovery wells | | | **C** | **C** | **C** | | | | | | | | | |
| Oiled sediment removal | | | **C** | **C** | **C** | **C** | | | | | | | | |
| Ambient water flooding (Deluge) | | | **C** | **C** | **C** | **R** | **R** | **R** | | | **C** | | | **C** |
| Amb water flush <50 psi | | **C** | | | **C** | **C** | **C** | **C** | | **R** | **C** | | | **C** |
| Amb water flush <100 psi | | | | | | | | | | | | | | |
| Warm water flush <90°F | | | | | | | | | | | | | | |
| Hot water flush >90°F | | | | | | | | | | | | | | |
| Vacuum removal of oil | | | | | | | **C** | **C** | | | | | | **C** |
| Sediment reworking | | | **C** | **C** | **C** | **C** | | | | | | | | |
| Sediment Removal-cleaning-replacement | | | **C** | **C** | **C** | | | | | | | | | |
| Cutting oiled vegetation | | | | | | | **C** | **C** | | **C** | **C** | | **C** | **C** |
| ALTERNATIVE METHODS* | | | | | | | | | | | | | | |
| In-situ burning of shore | | | | | | | | | | | | | | |
| Chemical stabilization, protection, cleaning | | | | | | | | | | | | | | |
| Nutrient enhancement | | | **C** | **C** | **C** | **C** | **C** | **C** | | | | | | **C** |
| Microbial addition | | | | | | | | | | | | | | |

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# SHORELINE COUNTERMEASURES MATRIX

## Very Light Oil (Jet fuels, Gasoline)

- Highly volatile (should all evaporate within 1-2 days)
- High concentration of toxic (soluble) compounds
- Result: Localized, severe impacts to water column and intertidal resources
- Duration of impact is a function of the resource recovery rate
- No dispersion necessary

### SHORELINE TYPES CODES

1- Exposed rock shores and vertical, hard man-made structure (e.g. seawalls)
2 - Exposed wave-cut platforms
3 - Fine to medium grained sand beaches & steep unvegetated river banks
4 - Course grained sand beaches
5 - Mixed sand and gravel beaches, including artificial fill containing a range of grain size and material
6A - Gravel beaches - pebbles to cobble
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6C - Exposed rip rap
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8A- Sheltered vertical rock shores and vertical, hard man-made structures (e.g. seawalls, docks,
8B - Sheltered rubble slope
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| COUNTERMEASURES | SHORELINE TYPES 1 | 2 | 3 | 4 | 5 | 6A | 6B | 6C | 7 | 8A | 8B | 9A | 9B | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONVENTIONAL METHODS | | | | | | | | | | | | | | |
| No action | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** | **R** |
| Manual removal of oil | | | | | | | | | | | | | | |
| Passive collection of oil | | | **C** | **C** | **C** | **C** | **C** | **C** | | | | | | |
| Oiled debris removal | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** | **C** |
| Trenching/recovery wells | | | **C** | **C** | **C** | | | | | | | | | |
| Oiled sediment removal | | | | | | | | | | | | | | |
| Ambient water flooding (Deluge) | | | | | | | | | | | | | | **C** |
| Amb water flush <50 psi | | | | | | | | | | | | | | |
| Amb water flush <100 psi | | | | | | | | | | | | | | |
| Warm water flush <90°F | | | | | | | | | | | | | | |
| Hot water flush >90°F | | | | | | | | | | | | | | |
| Vacuum removal of oil | | | | | | | | | | | | | | |
| Sediment reworking | | | **C** | **C** | **C** | **C** | | | | | | | | |
| Sediment Removal-cleaning-replacement | | | | | | | | | | | | | | |
| Cutting oiled vegetation | | | | | | | | | | | | | | |
| ALTERNATIVE METHODS* | | | | | | | | | | | | | | |
| In-situ burning on shore | | | | | | | | | | | | | | |
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